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FORUM FOR INTERNATIONAL COOPERATION ON FIRE RESEARCH*

INTRODUCTION

This Symposium is about fire safety engineering and the development of performance codes for fire safety. It is the second conference in a series, the first of which was in Sydney, Australia last year. The Australian Symposium was exciting because of the impressive efforts underway there to develop and introduce a performance-based fire code. Not to be outdone, this year's Symposium features another such code, the proposed Nordic Model Performance Code. That's fantastic! Our hats are off to Pentti Loikkanen and the other organizers of this Symposium. We hope this series will extend for a number of years and to a number of countries.

What we are talking about are major changes to longstanding practices in fire safety. We are talking about shifting from dependence on traditional rating and ranking procedures to scientifically-based, quantitative methods for assessing the cost-effectiveness of combinations of fire safety measures. Alternatively stated, we are talking about engineering fire safety into products and facilities, with the same confidence we engineer structural stability into buildings today. Further, safe driving of automobiles or flying of airplanes requires that the operators understand the capabilities and limitations of their vehicles and the systems in which they operate. Likewise, to be effective fire safety education needs to be founded on a similar basis of knowledge and understanding.

The potential benefits of this transition to engineered fire safety are tremendous, and apparent to fire safety professionals around the world. We are united in our commitment to reduce the horror, agony, and economic burdens of fire in our communities. Our hope through these symposia is to accelerate the process of change.

The focus of this Symposium is upon what is happening here in the Nordic countries. The spotlight will be on the proposed Nordic Model Performance Code and the discussions of the steps to be taken for its implementation. Several of us will say a few words about what is going on elsewhere in the world as a frame of reference for you to use in gauging how to proceed here. By the same token, those of us from other nations are here to learn from you, about the progress you have made in the development and application of fire safety engineering tools and practices. We all stand to gain from this Symposium, since we are all influenced by emerging global markets and international standards.

For my part, I want to talk briefly about a group that is dedicated to making this transition happen as quickly and smoothly as possible. I am referring to the FORUM for International

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Cooperation on Fire Research. What I wish to do in the next few minutes is to tell you about this group, who we are, what we are about, what we have done to date. I will offer some thoughts about what is necessary on all our parts to make the movement to fire safety engineering successful; and, in closing, urge each of you to take a few specific actions.

FORUM: WHAT IT IS, IS DOING, AND WHERE IT IS GOING

The FORUM is an informal group of individuals committed to reducing the burden of fire through international cooperation on fire research and in the application of fire research results. It was formed in 1988 to bring together heads of organizations throughout the world who direct resources into fire research.

Like any group formed of persons of similar positions, the FORUM provides its members the opportunity to share with and learn from peers. The FORUM meets annually to exchange technical and program information, work questions of mutual interest and seek opportunities for cooperative research and collaboration that advance our common objectives, including the transfer of research results and other actions to promote the findings of the FORUM. I have been asked to serve as chairman and Ken Richardson of IRC Canada is the secretary. Participants in FORUM meetings to date have been from CSIRO in Australia, IRC Canada, VTT Finland, CSTB France, BRI and FRI Japan, New Zealand, SINTEF Norway, People's Republic of China, ITSEMAP Spain, BRANDFORSK Sweden, BRE UK, and NIST and FMRC USA.

Collectively, these organizations employ about 300 fire research professionals, maintain the world's best research, burn and fire test facilities and equipment, and are embedded within some of the world's finest scientific research organizations. Their combined resources represent the level of funding needed to bring fire science and engineered fire safety to the point where we all would like to see it in our own nations. That is, a point where a desired level of fire safety can be engineered reliably into products and facilities.

The FORUM seeks open and effective exchanges on matters of mutual interest with other organizations including specifically, fire safety associations, standards bodies, and professional organizations. To date, such communications have included ASTM, CEN/127, CFP, CIB W-14, CIVCEA, IEC SC50D, International Maritime Organization, International Association for Fire Safety Science, ISO TC 92, National Fire Protection Association, Society of Fire Protection Engineers, and their UK counterparts the Society of Fire Safety Engineers.

Five meetings of the FORUM have been held to date, the sixth will convene later this week here in Espoo. These meetings have addressed fire research needs requiring international cooperation, development of scientifically-based tools of "Fire Safety Engineering" to reduce the limitations of restrictive, prescriptive standards and codes, emerging fire test methods, and possibilities for cooperative research at the international level focussing most likely on validation of fire hazard and risk models. (A summary report on the FORUM appears in the Proceedings of the Third IAFSS Symposium¹.)

From these meetings, four general objectives for the FORUM have emerged. I will briefly comment on each of them.

1. **Promote fire research.** We are all concerned with quality, responsiveness to real world needs and the timeliness of our products.

a. International fire research needs. The first product of the FORUM was a compilation of research needs based on the inputs from the groups noted above. Not surprisingly, work on each of those topics is now underway in one or more FORUM laboratories.

b. Increase funding for fire research. FORUM participants share concerns over the potential consequences of the continued, mostly downward, trend in funding of fire research. Our concerns include potential continued increases in the costs of fire to society, absence of adequate preplanning and/or mitigation strategies for a kilo-death fire, major fire losses from natural/other disasters, HAZMAT (Hazardous Material) incidents, increases in the regulatory burden of traditional fire safety practices, and inability to provide satisfactory quantitative tools for fire risk management.

Participants agree that the gravity of these concerns needs to be communicated to regulatory officials, industry, politicians, and government agencies so that this issue does not become the fatal tripping point in the progress of fire safety engineering.

c. Support IAFSS, Interflam, and other International Fire Safety Engineering Conferences. These are the premier means for presenting fire research results and applications. The capabilities of the FORUM participants are limited, therefore, it is desirable that we concentrate our energies in helping to support these efforts. Such support is in the form of staff submission of papers, funding, and participation. For example, in the three meetings of IAFSS to date, roughly 40-50% of the papers have been from or sponsored by a FORUM participant's organization. Likewise, many of the presentations at this conference represent work sponsored or conducted by FORUM participants.

2. **Advance fire safety engineering.** Accelerated development and acceptance of scientifically-based fire safety engineering methods and practice is one of the major motivations for international fire research. Already, the FORUM has taken several steps to coordinate development of fire models, measurement methods, and data, and to articulate FORUM positions on key technical issues. For example, FORUM participants are encouraging development of the cone calorimeter and related heat release rate measurement techniques, have communicated with ISO and CEN concerning the necessity of "rational" methods as an alternative to traditional tests and offered similar views on methods for the testing of upholstered furniture. The health, vision, vitality and assertiveness of the leading fire safety engineering organizations in the world are critical to progress in fire safety. FORUM participants support the activities of SFPE and SFSE, support participation of their staff in them, and will continue to work together with these organizations to accelerate the advance of fire safety engineering.

3. **Facilitate technology transfer.** This is a broad and generally undersupported aspect of fire research management, i.e., getting practical results out and into use. FORUM participants encourage technology transfer through staff exchanges, exchange of research information and results including coordination among our libraries and INFIRE (an international group coordinating fire research libraries), and cooperation in investigations and disaster response.

Sponsorship of national Symposia such as this are among the most important things the FORUM does.

4. Optimize use of scarce resources. Cooperation and collaboration are essential for all of the FORUM participants. No one of us can afford to go it alone. No one of us has the capabilities to do it. The FORUM serves as a mechanism to reduce the likelihood of misunderstandings and maintain a healthy balance between the sometime conflicting forces among us.

In summary, the FORUM is proactive in advancing the cause of fire safety engineering through research directed to reduce the burdens of fire. It seeks to complement the roles and functions of existing fire safety bodies and looks forward to continued, mutually beneficial cooperation with all. We would welcome your suggestions on how we can better serve you.

IMPLICATIONS TO FIRE SAFETY ENGINEERING IN THE NORDIC COUNTRIES AND AROUND THE WORLD: SUGGESTED ACTIONS

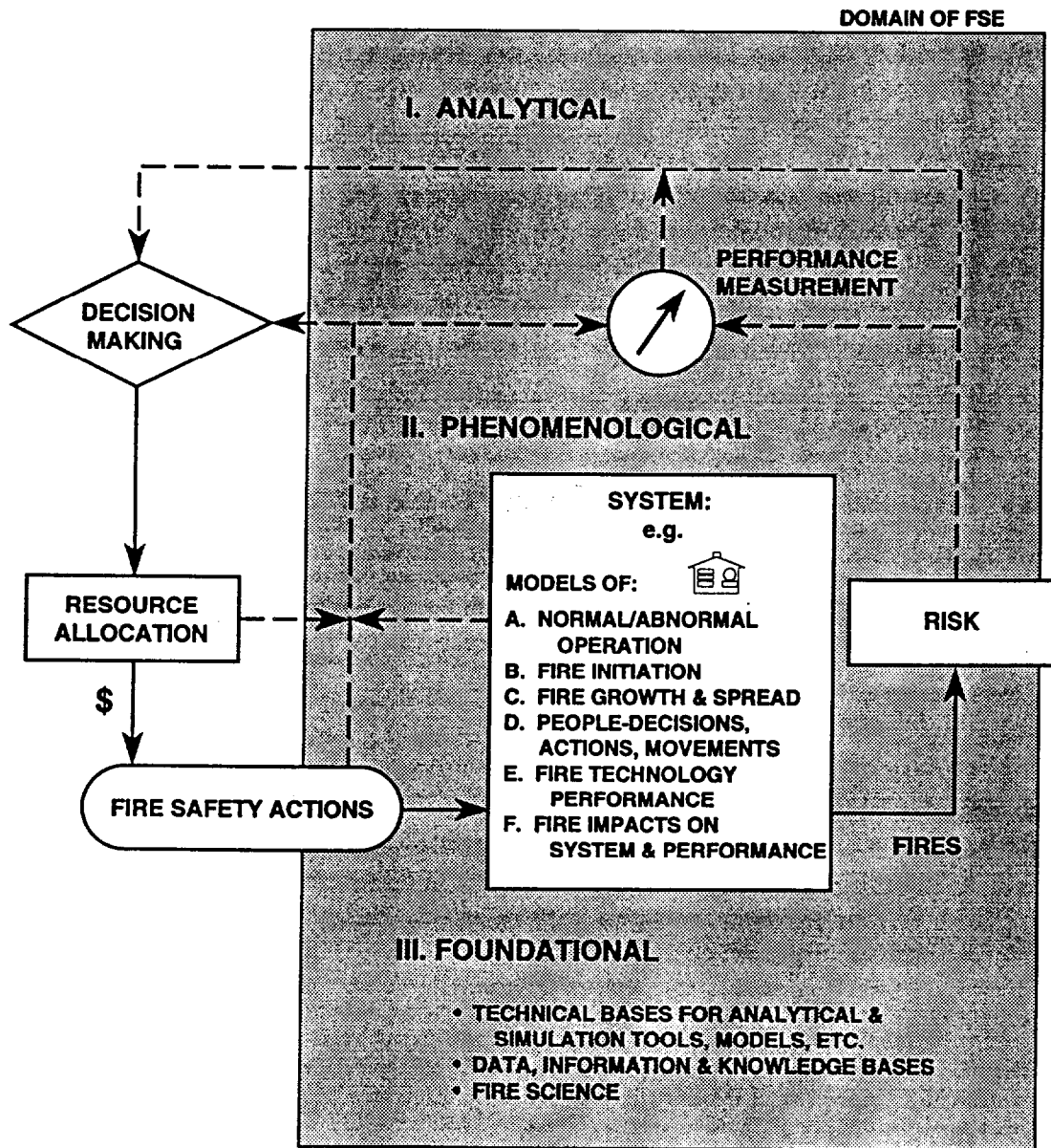
A great deal of attention has been devoted to fire safety engineering recently - what it is, how it needs to be different from traditional fire safety practice, what tools and practices it involves and what is needed to accelerate its development. For example, the recent Interflam meeting in which many of us participated was devoted almost exclusively to this topic, and in a couple of weeks there is a CIB W14 Symposium on Fire Safety Engineering in Ulster^{2,3}. The Society of Fire Protection Engineering defines it as,

"the application of science and engineering principles to protect people and their environment from destructive fire and includes: analysis of fire hazards; mitigation of fire damage by proper design, construction, arrangement, and use of buildings, materials, structures, industrial processes, and transportation systems; the design, installation, and maintenance of fire detection and suppression and communication systems; and post-fire investigation and analysis."

Nelson draws a distinction between fire safety management - deciding how much fire safety is required - and fire safety engineering - determining how to provide it⁴. Figure 1 illustrates this distinction where the shaded portion is fire safety engineering and the rest, left hand side, of the figure is fire safety management. This figure further delineates the scope of fire safety engineering by indicating that it involves a) analytical elements including quantitative expression of fire safety requirements and measures of performance of the systems for which fire safety is an issue; b) phenomenological elements relating to fire and the determinants of fire hazard and risk; and c) foundational elements relating to the science of combustion, fire, human behavior and the technologies underpinning fire safety engineering practice and tools⁵. FORUM members and the organizations we lead are concerned with all three of these sets of elements.

The longstanding goal of fire safety engineering is to reduce fire loss and cost. Doing this requires both a changed cultural orientation - attitudes, values, behaviors - towards fire and effective use of advanced technologies. The fire safety engineer can be influential in both these spheres. Critical to the success of fire safety engineering are measures of performance as

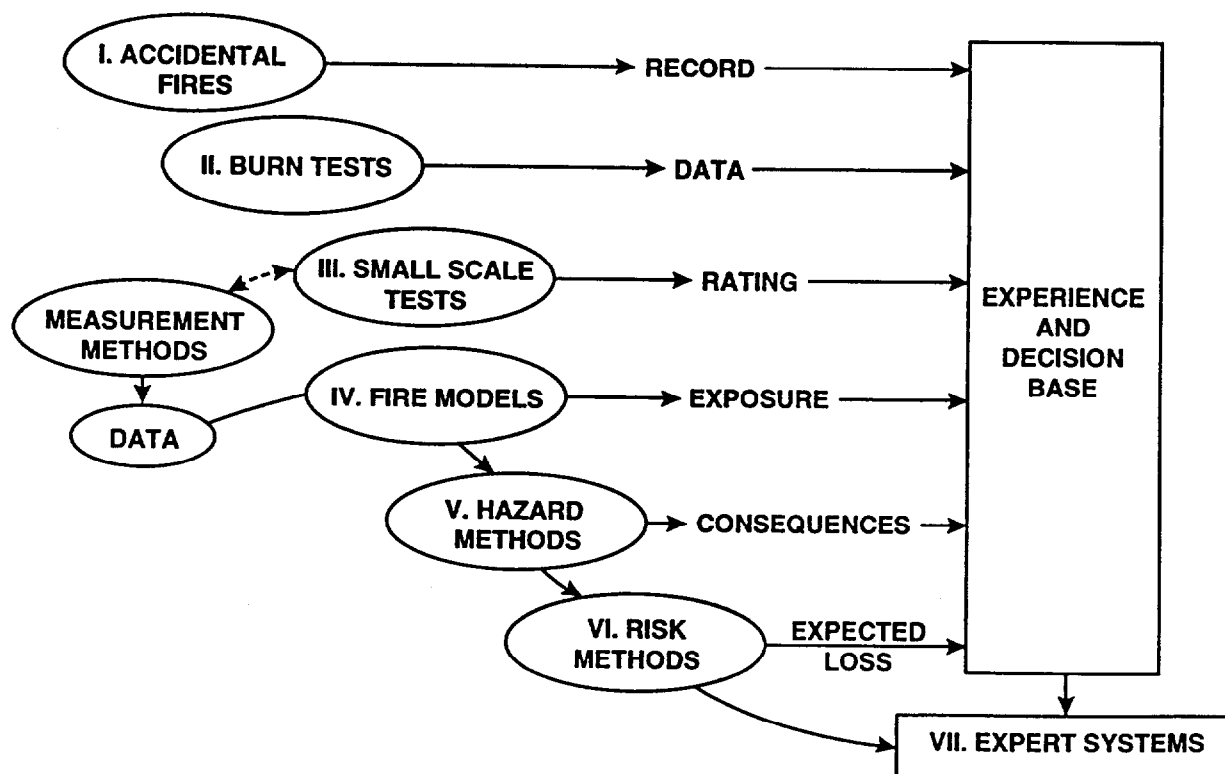
Figure 1. Framework for Fire Safety Engineering



indicated by the gauge in Figure 1. Cost-effectiveness measures of fire safety efforts, be they behavioral or technical, of necessity involve quantification of fire hazard and risk. In the distant past, this was impossible except retrospectively in examination of and response to actual fire experience. Figure 2 traces the evolution of fire safety evaluation methodology over the last hundred years or so in a series of numbered steps⁶. The figure also indicates the sorts of information provided by the methods - ranging from records of accidental fires and more recently statistical analyses of these, to now highly sophisticated simulations and computer predictions of fire hazard and risk in units meaningful to public decision-makers. Note the significant shift between steps III. and IV. from primarily reactive to proactive/predictive methods. Today's fire safety engineer has all of these tools available. Tomorrow's fire safety engineer will use highly sophisticated expert systems, step VII, which draw on this integrated knowledge base, in computer-based and user friendly form to evaluate, predict, and/or design alternative fire safety solutions. Similar tools crafted from this same knowledge base offer exciting potential for training and education for fire service and building regulatory officials, for fire fighters and fire prevention specialists, and for fire safety training and education of health care workers, school children, etc. As these tools become refined, they will equip the fire safety engineer to conduct analyses and make predictions with the same certitude and rigor his colleagues in civil and aeronautical engineering have been able to apply for decades.

Figure 2.

EVOLVING APPROACHES FOR FIRE SAFETY ANALYSIS



This expanded set of capabilities raises a number of issues that must be addressed before the benefits of the new technologies can be realized. These include the following:

1. Overcoming institutional resistance to change.
2. Providing adequate support for fire research and effective transfer of the results into practice.
3. Validating/verifying fire risk and hazard models and other fire safety engineering tools.
4. Availability of data for fire safety engineering methods.
5. Establishing internationally accepted, scientifically sound methods for product performance evaluation and approval.
6. Developing technical bases for performance-based design evaluation, and building codes.
7. Methods for "as-built" performance - inspection, monitoring, maintenance.

Undoubtedly, in our discussions over the next two days, additional issues will be identified that should be added to this list. Let us keep track of these issues so we have a clear agenda for the way forward.

We must also, work together to resolve these issues. Necessary conditions for our success in so doing include the following:

1. A coordinated global research and development effort, and national variants to meet exigencies of unique national needs, in the areas of . . .
 - a. Fire research and fire modeling.
 - b. International fire model validation and related large scale tests/experiments.
 - c. Fire risk assessment methods and data, including Bayesian models to generate probabilities for non-recurrent fire events.
2. Open systems design for fire, fire hazard and fire risk models.
3. Non-exclusive bases for fire safety engineering software, which receive international peer review, Beta testing and trial applications, and ultimately standardization.

4. Standardized data formats and cooperatively networked databases among the nations of the world.
5. Internationally recognized, standardized fire safety engineering training and certification.

Again, our discussions over the next two days should improve this sense of what solutions must look like, so we need to keep track of areas of consensus as we achieve them in our discussions.

In a recent series of talks, Bud Nelson⁷, has suggested the following organizational assignments for addressing these issues:

Provide the knowledge base:	FORUM members, Academic researchers.
Produce the data:	Testing houses, standards organizations.
Provide the methods/tools:	FORUM members, academia.
Transfer the new technology:	Academia, professional societies, practicing engineers.
Competence:	All of us.

Beyond these issues and actions, there are steps each of us can take to help accelerate the development of fire safety engineering. I urge everyone here to think critically as you listen to each paper in the Symposium and consider personally the following challenges:

1. Consider what can you do to provide **leadership** or **support** to advance the cause of fire safety engineering. Seize the opportunity now, you will be well served in so doing.
2. Seek out and challenge me or other members of the **FORUM** with your suggestions on how we may better build international cooperation in defining and directing resources to the needed coordinated research.
3. Work through **IAFSS** and respected **international journals** to accelerate the development and peer review of the needed research and the development of the necessary tools.
4. Participate actively in **SFPE** as a key organization to define and refine what is meant by fire safety engineering: its content, educational curricula, professional and ethical standards, and tools and practices.
5. Work with/within to the world's **fire safety organizations** to support the training, education, codification of practice of fire safety engineering; and to the world's pre-standardization organizations CIB, and standards organizations, primarily

ISO, to ultimately standardize the basic algorithms underlying tools and world certification authorities, as under ISO 9000, to certify the applicability of individual software packages designed to meet internationally accepted requirements.

If individually, we do these things, the promise of fire safety engineering will blossom in no time. It will happen no sooner than we make it.

CLOSE

In closing, I am honored to have had this opportunity to participate in this exciting conference. I know that you will all benefit greatly from the papers and discussions of the next two days.

If you have suggestions for the FORUM, please bring them to me or any of the other FORUM members here.

The ultimate realization of the vision I boldly asserted at the beginning of this talk depends on what each of us does after we leave this place. Please remember: the capability to engineer fire safety is within our reach.

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